Art. III.—*On the Occurrence of Glacial Beds at Wynyard, near Table Cape, Tasmania.*

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(With Plate III.).

[Read 3rd April, 1902.]

The beds referred to occur on the north-west coast of Tasmania, at and near the township of Wynyard, as may be seen from the accompanying map. This is based on the map of Tasmania, compiled in the Surveyor-General's Department, Hobart, and published in 1899. Scale, 8 miles to 1 inch.

The only papers on the geology of the district that I have seen are those specified hereunder.[1]

In the locality under review the beds extend along the coast from a point about midway between Table Cape and the mouth of the Inglis River at Wynyard, to some little distance past the mouth of Seabrook Creek, which enters Bass Strait about 3 miles east of the Inglis River. The whole of the outcrops of the beds east of the Inglis occur at, or little above, sea level, and for the greater portion of the distance can be seen only at low tide. The same remarks apply to the area west of the Inglis; but here the presence of cliffs along the shore line enables the beds to be seen in section, though only to the depth of a few feet.

On the western side of the Inglis, near its mouth, bluish-grey shales with occasional pebbles are observable at low tide. They

1 T. Stephens, M.A.: Remarks on the Geological Structure of Part of the North Coast of Tasmania, with special reference to the Tertiary Marine Beds near Table Cape—Proc. Roy. Soc. Tasmania, 1869. R. M. Johnston, F.L.S.: Further Notes on the Tertiary Marine Beds of Table Cape—Proc. Roy. Soc. Tasmania, 1876. R. A. Montgomery, M.A.: Report on the Mineral Fields of the Gawler River, Penguin, Dial Range, Mount Housetop, Table Cape, Cam River, and portion of the Arthur River Districts—Report of Secretary for Mines, Tasmania, 1895-6. G. A. Waller: Report on the recent discovery of Cannel Coal in the Parish of Preolenna, and upon the New Victory Mine, near Arthur River—Report Dept. of Mines, Tasmania, 1901-2.

have a low dip of 4° to 7° from about south-west to west. These shales show rather pretty curves in the beds, and can be traced to the adjacent cliff, where a bed of conglomerate of varying thickness up to 6 feet overlies them on the eastern side of the point, which has been called Sandy Cove Bluff by Mr. Johnston. This bluff, about 180 feet high, consists of a series of fossiliferous beds of limestone of Eocene age capped by basalt. Mr. Johnston has illustrated it by section in the paper quoted.

The Eocenes are divided by Mr. Johnston into two convenient divisions; the lower, the Crassatella bed, a few feet only in thickness; the upper, the Turritella bed, 78 feet thick. Overlying this is a mass of volcanic rock (basalt, etc.) over 80 feet in thickness. The Turritella bed is of special interest as it contains leaves of dicotyledonous plants as well as marine shells, and in it, also, has been found the oldest known Australian marsupial, which Professor Spencer, M.A., F.R.S., has described[1] under the name of Wynyardia bassiana.

Further north-west, on the opposite side of Sandy Cove, the beds appear in better section, and consist of boulder clay merging into conglomerate. Overlying this is a conglomerate of Eocene age derived from the glacial beds. This conglomerate contains numerous remains of mollusca, corals, etc. It varies up to about 4 feet in thickness, and clearly indicates the littoral nature of the beds. This Eocene conglomerate can also been seen in the cliff at Sandy Cove Bluff, but there it occurs only in very small patches.

Nearer Table Cape, in Freestone Cove, the till passes upwards into a fine-grained, greenish-grey argillaceous sandstone, with few pebbles; and some distance seawards a patch of this rock forms an islet, standing several feet above the general level of the sea floor.

The surface of the glacial beds on which the marine Eocenes have been laid down is rather uneven, and consequently the Eocenes come to sea level, and again rise above it before finally disappearing beneath it about one mile to the north-west of Sandy Cove, where the basalt of Table Cape forms the cliffs.

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1 Professor W. Baldwin Spencer, M.A.: A Description of Wynyardia bassiana, a Fossil Marsupial from the Tertiary Beds of Table Cape, Tasmania—Proc. Zool. Soc. London, 1900, pp. 776-795.

The till consists of a matrix of tough mud, with embedded pebbles, blocks, and masses of various rocks in greater or less number.

In general appearance it has a strong resemblance to the glacial beds near Bacchus Marsh, Victoria, described[1] in various publications by Professor David, B.A., F.R.S., and Messrs. E. J. Dunn, F.G.S., G. Officer, B.Sc., L. Balfour, B.A., E. G. Hogg, M.A., Geo. Sweet, F.G.S., and C. C. Brittlebank, and to those recently described[2] by Professor E. G. Hogg, M.A., as occurring at Little Peppermint Bay, south of Hobart, Tasmania. Both of these occurrences are regarded as of Permo-Carboniferous age.

The included pebbles in the Wynyard beds are rounded, sub-angular, and angular in shape. Many of them, especially those of a softer nature, show distinct striae. They comprise various rocks, such as indurated and normal sandstones, quartzites, lydianite, banded and ordinary jaspers, quartz of several colors, felsites and mica schists of various colors and kinds, spotted mica schist, quartz schist, indurated fine conglomerates, lode quartz showing included pieces of slate, fine-grained grey and red granitoid rocks, argillaceous and siliceous slates and shales, hornstones, coarse grey aplite, agates, chalcedony, fossiliferous and non-fossiliferous crystalline limestone, and several varieties of igneous rocks of dark color and fine and medium texture.

E. J. Dunn, F.G.S.: Notes on the Occurrence of Glaciated Pebbles and Boulders in the so-called Mesozoic Conglomerate of Victoria—Proc. Roy. Soc. Victoria, vol. xxiv., pt. i.; The Glacial Conglomerates of Victoria—Aus. Ass. Advt. Science, Melbourne, 1890. Graham Officer, B.Sc., and Lewis Balfour, B.A.: Preliminary Account of the Glacial Deposits of Bacchus Marsh—Proc. Roy. Soc. Victoria, vol. v., n.s., 1892; Further Note on the Glacial Deposits of Bacchus Marsh—Proc. Roy. Soc. Victoria, vol. vi., n.s., 1893. Geo. Sweet, F.G.S., and C. C. Brittlebank: The Glacial Deposits of Bacchus Marsh District—Aus. Ass. Advt. Science, Adelaide, 1893, vol. v. The Glacial Deposits of Bacchus Marsh, G. Officer, L. Balfour, and E. G. Hogg, The Glacial Geology of Coimaidai—Aus. Ass. Advt. Science, Brisbane, 1895, vol. vi. Professor T. W. Edgeworth David, B.A., F.G.S.: Evidences of Glacial Action in Australia in Permo-Carboniferous Time—Quart. Jour. Geol. Soc., May, 1896, vol. lii., part ii. C. C. Brittlebank, Geo. Sweet, F.G.S., and Professor T. W. Edgeworth David, B.A., F.G.S.: Further Evidence as to the Glacial Action in the Bacchus Marsh District, Victoria—Aus. Ass. Advt. Science, Sydney, 1898, vol. vii. Graham Officer, B.Sc., and Evelyn G. Hogg, M.A.: The Geology of Coimaidai, Part i.—Proc. Roy. Soc. Victoria, vol. x., n.s., pt. i., 1897; The Geology of Coimaidai, Part ii.—Proc. Roy. Soc. Victoria, vol. x., n.s., pt. ii., 1897.

2 Professor E. G. Hogg, M.A.: The Glacial Beds of Little Peppermint Bay, Tasmania —Report of Secretary for Mines, Tasmania, 1900-1, and Proc. Roy. Soc. Tasmania, 1902.

These are like dense basalt, and show clusters of dark-colored crystals, probably augite.

The included rocks vary in size from mere gravel to blocks of granite, quartzite, and sandstone, several tons in weight. One of these granite blocks may be seen embedded in fine sediment in Freestone Cove, and large blocks of highly-jointed quartzite occur in the uppermost portion of the bed on the north-eastern point of Sandy Cove Bluff. Small pieces of these quartzites are observable in the immediately-overlying Eocene derived conglomerate. Veins of calcite up to several inches in thickness traverse the glacial beds in various places.

Fossils have been found in some of the pebbles of the glacial conglomerate. They have been described[1] by Mr. Robt. Etheridge, jun., as Silurian types, comprising Pentamerus tasmaniensis, R. Etheridge, fils; Spirifer, 3 spp.; Strophomena (?); Tentaculites; Orthis; and Atrypa (?). No fossils, however, of contemporaneous age have been noticed in the glacial deposits, as has already been pointed out by Messrs. Stephens and Montgomery.

Mr. Stephens has described[2] these Wynyard conglomerates as follows:—"The horizontally bedded conglomerates and breccias of very variable character and uncertain age which occur at intervals between Port Sorell and Table Cape appear to come next in geological order, but may belong to the last-named series of rocks" (the Mersey Coal Measures of Permo-Carboniferous age). " . . . At the mouth of the Inglis . . . . large angular blocks of granite and porphyry, the former sometimes weighing several tons, together with rolled pebbles of many of the Primary rocks, are here seen embedded in a fine-grained mudstone, this being evidently derived from the denudation of some of the softer slates, and deposited as mud on the margin, or in the bed of some ancient river or estuary, which occupied a basin with nearly the same principal boundaries as the modern Inglis. These massive blocks of granite and other rocks, which are not now found *in situ* within several miles of their present position, I consider to

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1 R. Etheridge, jun.: Description of Remains of Trilobites from the Lower Silurian Rocks of the Mersey River, and Brachiopoda from the Conglomerate of Table Cape—Proc. Roy. Soc. Tasmania, 1882.

2 *Loc. cit.*

furnish more conclusive evidence of glacial agency in the geological history of Tasmania than I have met with elsewhere, and they strongly corroborate the testimony afforded by the seemingly erratic boulders which occur at various points in the basin of the S. Esk."

Mr. Montgomery, in speaking of these conglomerates, says[1]:—"In New South Wales it has been noted that both above and below the Greta Coal Series, which corresponds with the Mersey Coal Measures of Tasmania, there occur layers of erratic boulders, probably deposited by ice during periods of continued low temperature in the Southern Hemisphere. These cold periods might supply an explanation of the paucity of fossils in the Wynyard formation, and ice action would likewise account for the occurrence of large and heavy boulders in it in a mudstone matrix, instead of the more usual one of coarse sand and gravel, which is the ordinary result of the sorting of detrital material by wave action. During my examination, however, I did not see any boulders exhibiting ice striation, or of such size as not to be accountable for by the ordinary forces at work on every sea shore."

Besides the rocks already mentioned by him Mr. Stephens says:—"Among the rolled pebbles which line portions of the beach near Table Cape . . . . . there have been found from time to time fragments of a hard compact shale, varying in color from dark brown to dull black, and so closely resembling the so-called 'kerosene shale' of Hartley, N.S.W., both in appearance and behaviour under the simple tests to which I have subjected it, that they may be considered identical . . . . . and the discovery at different points of several specimens all identical in character, force us to the conclusion that it is of Pre-Tertiary age, and that portions of the series from which it has come, though removed by denudation near the coast line, will one day be found at no great distance inland."

Mr. Montgomery, also, referring to these loose fragments of coal found on the beach near Wynyard, says[2] that "high up in it" (the Wynyard formation) "the fossiliferous beds and the coal seam may yet be found."

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1 *Loc. cit.*
2 *Loc. cit.*

It is interesting to note that these predictions, first by Mr. Stephens, and later by Mr. Montgomery, have been fully verified, as the upper beds of the series to which the glacial deposits belong, and containing seams of cannel coal, as pointed out[1] by Mr. Geo. A. Waller, have been discovered some little distance inland from Wynyard, in the basin of the Inglis River.

At the mouth of the Inglis, east of the breakwater, till may be seen at low tide, and here appears about horizontal. About three-quarters of a mile further east shaly mudstones, very much jointed, show in the beach floor. They dip about N. 70° W. at 11°. The successively superimposed beds show beautiful serrated edges at right angles to the shore line, where the ever restless waves have furrowed them. There is also a pretty, wavy appearance along the different beds, and they are jointed to a great extent.

Traced further eastwards along the shore hard, tough conglomerates, consisting principally of normal and altered sedimentary rocks, are visible on the beach just to the west of Seabrook Creek, with an overlying bed, seen only in places, of an exceedingly hard, fine, dense, bluish-grey sandstone, greatly resembling many sandstones in the Victorian Mesozoic Coal Measures, even to their characteristic pitted weathering.

To the east of the point of basalt running into the sea on the eastern side of this creek blocks of similar conglomerate can also be seen. They contain veins of calcite up to 6 inches in thickness.

The glacial beds were not observed east of this place, the shore line as far as Burnie, wherever examined, being occupied by recent deposits, by basalt, or by highly inclined, folded and contorted siliceous slates, sandstones, and quartz schists, having a general strike between N.N.E. and N.E. These are regarded by Mr. Stephens as possibly forming the base of the Lower Silurian (Ordovician) series, or even of being still older in age, while Mr. Montgomery speaks of them as of Cambro-Silurian age.

They contain multitudes of quartz veins and small reefs, especially near Burnie. A number of anticlines and synclines can also be observed at low tide, the former especially being splendid examples, showing beautifully the rounded curves of the strata.

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[1] *Loc. cit.*

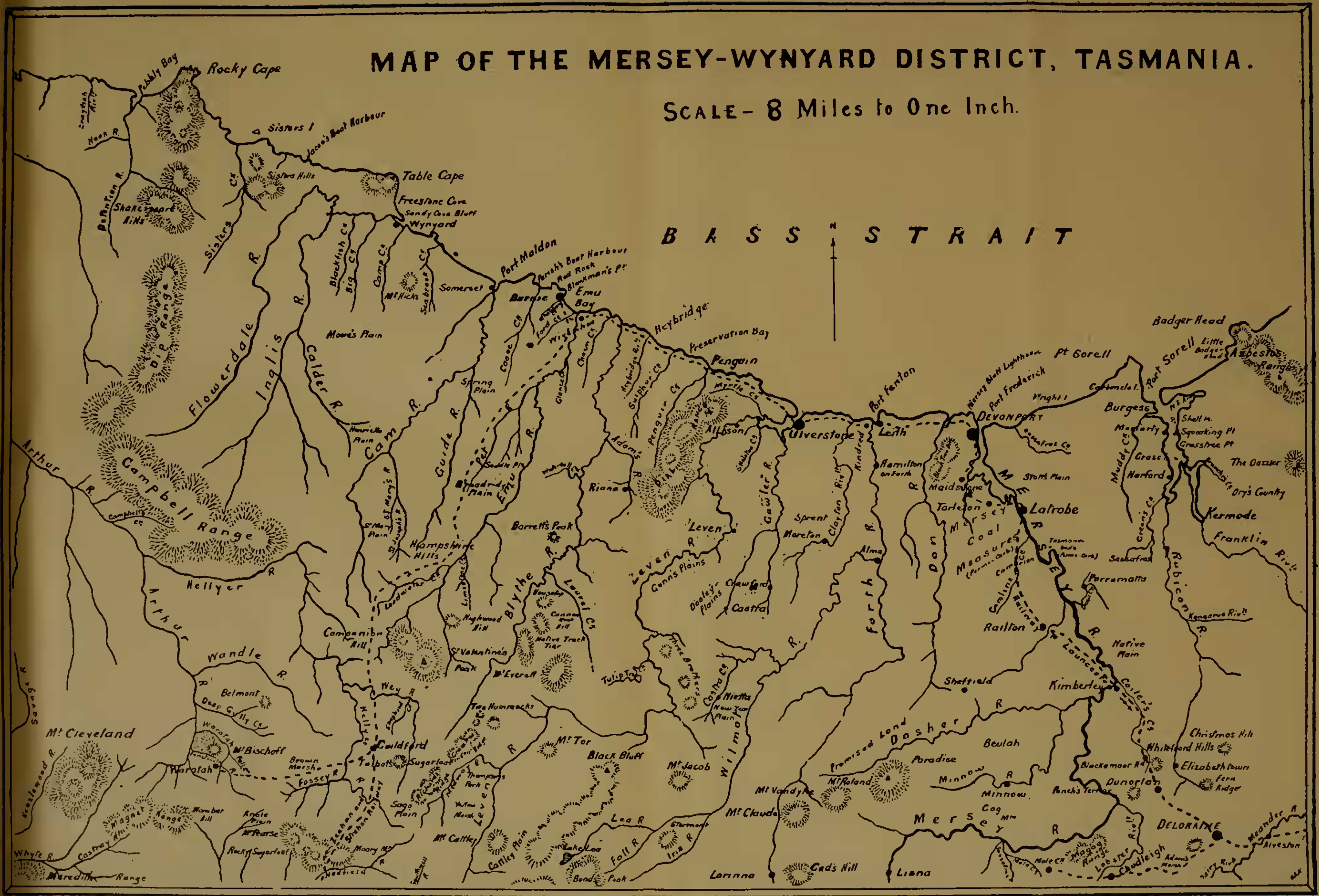
They also show numerous intrusions of igneous rocks of several kinds, occurring as dykes and lenticular patches, probably plugs. These can be seen specially between Cooee Creek and Burnie. The rock in some cases is of fine texture, and has a granitic appearance; in others it is like basalt, but very much decomposed. The intruded rocks are considerably altered along the contact, especially, as might be expected, in the case of the larger intruding masses, which have entangled among them blocks and pieces of the sedimentary rocks. Several of these igneous rocks have been examined by Mr. W. H. Twelvetrees, F.G.S., Government Geologist of Tasmania, and Mr. W. F. Petterd, who describe[1] them as gabbro.

The relation of these glacial beds of Permo-Carboniferous age to those of early Palaeozoic (Cambro-Silurian) age was not noticed by section anywhere along this part of the coast. Near Seabrook Creek their contact with the folded rocks was obscured owing to the flat nature of the beach, and its sandy character. Perhaps it may be visible at low tide.

The only place back from the coast where the glacial beds were noticed by me is in a small section about half a mile inland, near the bridge over the Inglis River on the Table Cape road. Here the rocks are shaly mudstones with pebbles, showing a dip of about 4° 30′ to N. 25° W. The contained pebbles are of rocks similar to those before mentioned. Mr. Montgomery, however, states[2] that the conglomerates, which he calls the "Wynyard Formation," occupy an extensive area to the south of Wynyard, between the Inglis and Cam Rivers, and as far back as the Campbell Range, and the Arthur River. He also says:—"It is possible that the Wynyard Formation is the base of the Coal Measures." Mr. Waller holds the same opinion, for he says[3]:—"There is now little reason to doubt that the 'Wynyard Formation' forms the base of the Permo-Carboniferous system."

The occurrence of coal seams in the same series as contains the glacial deposits is a matter of interest as tending to show the close relationship between the glacial deposits of Permo-

1 The Igneous Rocks of Tasmania—Trans. Aus. Inst. Mining Engineers, vol. v., 1898.
2 *Loc. cit.*
3 *Loc. cit.*


MAP OF THE MERSEY-WYNYARD DISTRICT, TASMANIA.
SCALE – 8 Miles to One Inch.
BASS STRAIT
Rocky Cape
Table Cape
Wynyard
Somerset
Burnie
Emu Bay
Penguin
Ulverstone
Leith
Devonport
Latrobe
Railton
Sheffield
Kimberley
Deloraine
Campbell Range
Hellyer
Leven
Forth
Mersey
Dasher
Waratah
Badger Head
Port Sorell
Kermode
Franklin
Rubicon